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prizes for works in science and art, commemorative of the establishment of the Commonwealth by Penn two hundred years ago. The competitors must be natives or residents of Pennsylvania, and the sums awarded are \$500 to \$1000. The prizes will be mostly presented to the association by private persons, and will bear their names. A number of them have been subscribed. Such prizes, numerous in Europe, are rare here, and are a most effective method of stimulating the higher forms of intellectual effort.

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RECENT LITERATURE.

LUBBOCK'S ANTS, BEES AND WASPS.¹—This volume is a reprint, with some omission of details, of Sir John Lubbock's papers which were read before the Linnæan Society of London. The volume is mainly devoted to ants, with a few pages referring to bees and wasps. The book is an important contribution to animal psychology, and is almost entirely a fresh record of facts observed by the author, who only refers to the observations of other naturalists for the purpose of introducing his own. Lubbock is a patient and most impartial observer, and is reticent as to ultimate questions, his method being purely inductive. However, at the outset Sir John feels disposed to place the ants next to man in intelligence, a position which may be disputed, as purely reasoning processes are perhaps at least as frequently observed in the mammals and birds, particularly the domesticated kinds, as in ants or bees.

We will now rapidly note the original discoveries of our author, such as prove to be additions to our stock of knowledge of insect mental traits. Lubbock is the first to show that in ants (*Myrmica ruginodis*), the queens have the instinct of bringing up larvæ and the power of founding communities; and not queens only, but, as has been shown by Denny, Lespès, Dewitz, and proved by Forel, the workers will lay eggs which produce males. Lubbock has further proved that the worker eggs only produce males. While it has formerly been supposed that ants live but one year, Lubbock kept two queens over seven years, and they "are probably more than eight years old." They seem in perfect health, and in 1881 laid fertile eggs, a fact which suggests physiological conclusions of great interest. He also has workers "more than six years old."

While English ants do not, as in warmer countries, lay up food for the winter, "they do more, for they keep during six months the eggs which will enable them to procure food during the following summer, a case of prudence unexampled in the animal kingdom."

¹ *Bees, Ants and Wasps*. A record of observations on the habits of the social Hymenoptera. By Sir JOHN LUBBOCK, Bart. New York, D. Appleton & Co.

As regards the slave-keeping propensity of ants and its effect upon the ant character, we have many fresh observations. During more than four years' observations of a nest of *Polyergus*, Lubbock's specimens "certainly never fed themselves, and when the community changed its nest, which they did several times, the mistresses were carried from the one to the other by the slaves." With Huber he does not doubt that specimens of *Polyergus*, if kept by themselves in a box, would soon die of starvation, even if supplied with food. "I have, however, kept isolated specimens for three months, by giving them a slave for an hour or two a day to clean and feed them; under these circumstances they remained in perfect health, while, but for the slaves, they would have perished in two or three days. Excepting the slave-making ants and some of the Myrmecophilous beetles above described, I know no case in nature of an animal having lost the instinct of feeding." In *Polyergus rufescens*, the so-called workers, though thus helpless and idle, are numerous, energetic and, in some respects, even brilliant. In another slave-making ant, *Strongylognathus*, the workers are much less numerous and so weak that it is an unsolved problem how they continue to make slaves. They make slaves of *Tetramorium cæspitum*, which they carry off as pupæ. The extreme in the series of slave-making ants is *Anergates*, which differs from all other ants "in having no workers at all." The male is wingless; they and the females are accompanied and tended by *Tetramorium cæspitum*. The *Anergates* are absolutely dependent upon their slaves, and cannot even feed themselves. Lubbock thinks male and female *Anergates* make their way into a nest of *Tetramorium* "and in some manner contrive to assassinate their queen." As regards the effect upon the character of the ants, we quote as follows from our author:

"At any rate, these four genera offer us every gradation from lawless violence to contemptible parasitism. *Formica sanguinea*, which may be assumed to have comparatively recently taken to slave-making, has not as yet been materially affected.

"*Polyergus*, on the contrary, already illustrates the lowering tendency of slavery. They have lost their knowledge of art, their natural affection for their young, and even their instinct of feeding! They are, however, bold and powerful marauders.

"In *Strongylognathus* the enervating influence of slavery has gone further, and told even on their bodily strength. They are no longer able to capture their slaves in fair and open warfare. Still they retain a semblance of authority, and when roused will fight bravely, though in vain.

"In *Anergates*, finally, we come to the last scene of this sad history. We may safely conclude that in distant times their ancestors lived, as so many ants do now, partly by hunting, partly on honey; that by degrees they became bold marauders, and gradually took to keeping slaves; that for a time they maintained

their strength and agility, though losing by degrees their real independence, their arts and even many of their instincts; that gradually even their bodily force dwindled away under the enervating influence to which they subjected themselves, until they sank to their present degraded condition—weak in body and mind, few in numbers, and apparently nearly extinct, the miserable representatives of far superior ancestors, maintaining a precarious existence as contemptible parasites of their former slaves.”

As to the passions of these creatures, Lubbock states that ants of the same nest never quarrel. “I have never seen the slightest evidence of ill-temper in any of my nests, all is harmony. Nor are instances of active assistance at all rare. Indeed, I have myself witnessed various cases showing care and tenderness on their part.” As to their recognition of one another, it appears that it is not personal or individual, “their harmony is not due to the fact that each ant is individually acquainted with every other member of the community. At the same time the fact that they recognize their friends even when intoxicated, and that they know the young born in their own nest even when they have been brought out of the chrysalis by strangers, seems to indicate that the recognition is not effected by means of any sign or pass word.” As to the power of communication, the results of a number of experiments taught our author that while they do not possess “any considerable power of descriptive communication,” on the other hand, there can, he thinks, be no doubt but that they do possess some power of the kind. He concludes that his experiments “certainly seem to indicate the possession, by ants, of something approaching to language. It is impossible to doubt that the friends were brought out by the first ant; and as she returned empty handed to the nest, the others cannot have been induced to follow her merely by observing her proceedings. In face of such facts as these, it is impossible not to ask ourselves how far are ants mere exquisite automatons; how far are they conscious beings? When we see an ant hill, tenanted by thousands of industrious inhabitants, excavating chambers, forming tunnels, making roads, guarding their home, gathering food, feeding the young, tending their domestic animals—each one fulfilling its duties industriously, and without confusion—it is difficult altogether to deny to them the gift of reason; and the preceding observations tend to confirm the opinion that their mental powers differ from those of men not so much in kind as in degree.”

While our author concludes that ants track one another by scent, he is inclined to adopt the mosaic theory of insect vision, and from experiments with the spectrum, concludes that “(1) ants have the power of distinguishing colors; (2) that they are very sensitive to violet; and it would also seem (3) that their sensations of color must be very different from those produced upon us.” The sense of hearing appears to be lodged in the antennæ,

certain stethoscope-like organs occurring there, though ants are deaf to ordinary sounds, still he thinks that ants perceive sounds which we cannot hear. On the other hand the sense of smell is highly developed, and how important this is in enabling them to find their way is shown in chapter ix, where are some curious statements both as to their apparent want of ingenuity, especially in constructing bridges and earthworks. Ants while guided by scent are also guided by sight, and are greatly influenced by the direction of the light.

In the chapter on bees he records experiments showing that honey bees "do not bring their friends to share any treasure they have discovered, so invariably as might be assumed from the statements of previous observers," and he has been a good deal surprised at the difficulty which bees experience in finding their way. His observations also teach him that "though bees habitually know and return to their own hive, still, if placed on the alighting-board of another, they often enter it without molestation." He was unable to discover any evidence of affection among bees, they appearing "thoroughly callous and utterly indifferent to one another." Contrary to the usual statements, he finds their devotion to the queen to be "of the most limited character," and the workers take no notice of their dead companions. Bees possess a keen power of smell, but like ants the sense of hearing is very dull; they possess, however, a color sense, preferring one color to another, blue being distinctly their favorite.

A brief final chapter is devoted to wasps, and Lubbock's experiments, "in opposition to the statements of Huber and Dujardin, serve to show that wasps and bees do not in all cases convey to one another information as to food which they may have discovered, though I do not doubt that they often do so." They are also not affected by sounds, and they are capable of distinguishing color, "though they do not seem so much guided by it as bees are."

The book has appendices giving details of experiments regarding the recognition by ants of friends after long separation, and on the power of communication of ants and bees, with notes on the industry of wasps, for Lubbock's investigations more than confirm the general belief as to the great industry of all these insects.

The work is a magazine of facts, materials for farther work on animal psychology. It should stimulate our youth of both sexes who are in any way interested in the study of nature, to observe patiently and thoroughly the habits of our insects. Any one of ordinary capacity can make similar observations, even those who are busy in other directions, for all of Sir John Lubbock's works have been prepared in moments snatched in the intervals of the life of a great banker and busy member of Parliament.